

CLAIMS

Claim 1. (currently amended) A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

- heating a metal alloy until it reaches a molten state;
- transferring an amount of said metal alloy, while in said molten state, to a vessel;
- cooling said amount of metal alloy in said vessel;
- applying an electromagnetic field to said amount of metal alloy for creating a flow pattern of said metal alloy within said vessel while said cooling continues in order to create a slurry billet of the desired thixotropic solid to liquid ratio for casting; and
- discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any heating step subsequent to said discharging from said vessel.

Claim 2. (original) The method of claim 1 wherein the performance of the transferring, cooling, applying, and discharging steps has a total cycle time of between 4 seconds and 250 seconds.

Claim 3. (original) The method of claim 2 wherein said transferring step is performed in between approximately 2 seconds and 35 seconds.

Claim 4. (original) The method of claim 3 wherein said cooling and said applying steps are performed in a combined time of between approximately 2 seconds and 120 seconds.

Claim 5. (original) The method of claim 4 wherein said discharging step is performed in between approximately 0.1 second and 30 seconds.

Claim 6. (original) The method of claim 1 wherein said transferring step is performed in between approximately 2 seconds and 35 seconds.

Claim 7. (original) The method of claim 1 wherein said cooling and said applying steps are performed in a combined time of between approximately 2 seconds and 150 seconds.

Claim 8. (original) The method of claim 1 wherein said discharging step is performed in between approximately 0.1 seconds and 30 seconds.

Claim 9. (original) The method of claim 1 wherein said transferring step includes the use of a robotic arm and a cooperating ladle.

Claim 10. (original) The method of claim 9 wherein said applying step is performed by moving said vessel into a stator before said transferring step is performed.

Claim 11. (original) The method of claim 10 wherein said cooling step is performed by providing a flow of cooling air between said vessel and said stator.

Claim 12. (original) The method of claim 10 which further includes the step of clamping a thermal jacket around said vessel, said thermal jacket being positioned within said stator and said clamping step occurring before said transferring step.

Claim 13. (previously amended) The method of claim 1 which further includes the step of moving said vessel into a stator before said transferring step is performed.

Claim 14. (original) The method of claim 1 wherein said cooling step is performed by providing a flow of cooling air between said vessel and said stator.

Claim 15. (original) The method of claim 1 which further includes the step of clamping a thermal jacket around said vessel, said thermal jacket being positioned within said stator and said clamping step occurring before said transferring step.

Claim 16. (original) The method of claim 1 wherein said transferring step includes the use of an automatic mechanical ladle.

Claim 17. (previously amended) The method of claim 1 wherein said stator is a multi-phase, multiple pole stator causing circumferential flow in the metal alloy.

Claim 18. (previously amended) The method of claim 1 wherein said stator is a multi-phase, multiple pole stator causing longitudinal flow in the metal alloy.

Claim 19. (original) The method of claim 1 which further includes the step of adding particulate solid particles into the metal alloy for forming a metal matrix composite.

Claim 20-23. (canceled)

Claim 24. (currently amended) A method of producing shaped metal parts from on-demand, semi-solid metal with degenerate dendritic primary solid particles, said method comprising the following steps:

heating a metal until it reaches a molten state;

transferring an amount of said molten metal to a vessel, while controllably cooling said amount of molten metal in said vessel;

applying an electromagnetic field to said amount of molten metal for creating a flow pattern of said molten metal within said vessel until a desired molding temperature within the semi-solid range is reached, thereby creating a slurry billet of the desired thixotropic solid to liquid ratio for casting; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any heating step subsequent to said discharging from said vessel.

Claim 25. (currently amended) The method of claim 24 which further includes the step of operating said casting machine in order to cast the slurry billet into the form of a shaped metal part.

Claim 26. (original) The method of claim 25 wherein the performance of the transferring, cooling, applying and discharging steps has a total cycle time of between 4 seconds and 250 seconds.

Claim 27-30. (canceled)

Claim 31. (currently amended) A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

heating a metal alloy until it reaches a molten state;

transferring an amount of said metal alloy, while in said molten state, to a vessel;

cooling said amount of metal alloy in said vessel;

applying an electromagnetic field to said amount of metal alloy by the use of a stator for stirring said metal alloy within said vessel while said cooling continues in order to create a slurry billet of the desired thixotropic solid to liquid ratio for casting, a voltage being applied to said stator, the level of said voltage determining the stirring torque applied to said metal alloy;

changing the voltage level applied to said stator so as to change the stirring torque applied to said metal alloy; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any heating step subsequent to said discharging from said vessel.

Claim 32. (previously added) The method of claim 31 wherein said voltage level is changed based upon the sensing of an electric load feedback signal.

Claim 33. (previously added) The method of claim 31 wherein said voltage level is changed based upon the sensing of a temperature measurement signal from said metal alloy.

Claim 34. (previously added) The method of claim 31 which further includes the step of changing the stirring torque applied to said metal alloy based upon the viscosity of said metal alloy in the vessel.

Claim 35. (currently amended) A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

heating a metal alloy until it reaches a molten state;
transferring an amount of said metal alloy, while in said molten state, to a vessel;
assembling a covering cap to said vessel in order to permit the use of an inert gas to control contamination;
cooling said amount of metal alloy in said vessel;

applying an electromagnetic field to said amount of metal alloy by the use of a stator for stirring said metal alloy within said vessel while said cooling continues in order to create a slurry billet of the desired thixotropic solid to liquid ratio for casting, a voltage being applied to said stator, the level of said voltage determining the stirring torque applied to said metal alloy; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any heating step subsequent to said discharging from said vessel.

Claim 36. (previously added) The method of claim 35 which further includes the step of inserting a thermocouple through said covering cap and into said metal alloy for deriving temperature information from said metal alloy.

Claim 37. (currently amended) A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

heating a metal alloy until it reaches a molten state;

clamping a thermal jacket around an alloy-receiving vessel;

transferring an amount of said metal alloy, while in said molten state, to said vessel;

cooling said amount of metal alloy in said vessel;

applying an electromagnetic field to said amount of metal alloy for creating a flow pattern of said metal alloy within said vessel while said cooling continues in order to create a slurry billet of the desired thixotropic solid to liquid ratio for casting; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any heating step subsequent to said discharging from said vessel.

Claim 38. (currently amended) A method of producing on-demand, semi-solid material for a casting process, said method comprising the following steps:

heating a metal alloy until it reaches a molten state;

arranging a plurality of stators around an alloy-receiving vessel, said plurality of stators including at least one rotary stator in combination with at least one linear stator;

transferring an amount of said metal alloy, while in said molten state, to said vessel;

cooling said amount of metal alloy in said vessel;

applying an electromagnetic field to said amount of metal alloy for creating a flow pattern of said metal alloy within said vessel while said cooling continues in order to create a slurry billet of the desired thixotropic solid to liquid ratio for casting; and

discharging said slurry billet from said vessel, directly and immediately, into a shot sleeve of a casting machine, without any intermediate stage of holding said slurry billet between said vessel and said shot sleeve and without any heating step subsequent to said discharging from said vessel.